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Shifting Between Models of Mind: New Insights Into How Human Minds Give Rise to Experiences of Spiritual Presence and Alternative Realities

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Abstract

Phenomenal experiences of immaterial spiritual beings—hearing the voice of God, seeing the spirit of an ancestor—are a valuable and largely untapped resource for the field of cognitive science. Such experiences, we argue, are experiences *of the mind*, tied to mental models and cognitive-epistemic attitudes *about the mind*, and thus provide a striking example of how, with the right combination of mental models and cognitive-epistemic attitudes, one's own thoughts and inner sensations can be experienced as coming from somewhere or someone else. In this paper, we present results from a large-scale study of U.S. adults ($N = 1779$) that provides new support for our theory that spiritual experiences are facilitated by a dynamic interaction between mental models and cognitive-epistemic attitudes: A person is more likely to hear God speak if they have the epistemic flexibility and cultural support to shift, temporarily, away from a mundane model of mind into a more "porous" way of thinking and being. This, in turn, lays the foundation for a meditation on how mental models and cognitive-epistemic attitudes might also interact to facilitate other phenomena of interest to cognitive science, such as fiction writing and scientific discovery.

Keywords: Spiritual experience; Absorption; Porosity; Cognitive science of religion; Mental models; Cultural models; Cognitive attitudes; Epistemic flexibility

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Preface: A reflection by T.M. Luhrmann, new fellow

I became interested in cognitive science in the 1980s. Those were early days both for me and for the field. I had gone to the University of Cambridge to get my doctorate in anthropology. In those days the department was quite philosophical. My advisor, Ernest Gellner, had trained in philosophy, my cohort was reading Wittgenstein and Bernard Williams—and Quine and Kripke and Putnam; at Cambridge, Foucault had not yet arrived in anthropology—and I was attending Elizabeth Anscombe's lectures. It seemed to me that to philosophers, the deep anthropological puzzle was how apparently reasonable people could believe apparently unreasonable beliefs. Often the explanation seemed to be that such people had not been properly exposed to science. The "rationality debate" (Hollis & Lukes, 1982; Wilson, 1974) *was in full swing, and for the most part, that debate focused very clearly on belief as a proposition that one held in one's head and that was the basis for action*. Horton (1993) *was arguing that African witchcraft served as a scientific explanation of a complex material world. I went off to London to redo Evans-Pritchard's (*1937*) famous study of Azande witchcraft among people who called themselves witches and magicians but who were also literate, college-educated, and certainly exposed to Western science*.

The problem that emerged for me in London was that these urban magicians did not so much believe in magical power but experienced it. They felt power flowing through their body. They dreamed about ancient gods and souls. They developed relationships with spirits who would talk to them and tell them what to do. That was what seemed to matter them, and their manuals and classes were not accounts of how you should think but what you should do.

By the time I was back and writing up, sorting through how to make sense of what I had seen, Pascal Boyer had arrived and had begun to hold workshops on what he called "cognitive science." We read Frank Keil, George Lakoff and Eleanor Rosch. From their perspective, the idea that humans acted because of internal propositional commitments was simply wrong. I understood enough to set out a theory about a learning process in which my magical participants acquired some systematic knowledge (about tarot, kabbalah, ancient European gods, etc.); performed mental imagery cultivation practices, which led them to have sensations that they could identify as "magical force," broadly conceived; and managed their cognitive commitments with shifting epistemic frames. In Persuasions of the Witch's Craft (1989a), *I called this "interpretive drift" and described it as a slow shift toward the willingness to behave as if magical force (and gods and spirits) was real. I wrote that magical practice was not really about belief at all*.

That people not only identified but experienced supernatural powers fascinated me. It seemed both terribly important and poorly understood and in need of a secular explanation that did not also invalidate a complex ultimate cause. I could see that these experiences felt spontaneous and yet in many ways depended on learning; people also said that some people were "better" at experiencing them than others. But I did not quite understand how to move forward in the research. I wrote a book on Parsi Zoroastrians (The Good Parsi, 1996), *which started as a book on religion and then galloped off in the spirit of its times; and a book on how young psychiatrists came to make sense of psychiatric illness* (Of Two Minds, 2000), *which among other things taught me that it was possible to study odd experiences systematically.*

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And then I encountered evangelical Christianity, and I observed that these Christians spoke about God much the way magicians spoke about magical force. These evangelicals were clear that if you wanted to know God, you had to pray; that prayer practice involved mental imagery cultivation and required learning; and that some people were "better" at praying than others, which meant that they experienced God more easily than others. And their experiences were in many ways quite similar to those of the magicians. They talked about hearing God speak, feeling his presence, and feeling the Holy Spirit shoot through their bodies.

That was when I began to work with psychologists and with psychological methods. I discovered that one account of why some people are better than others is absorption. People who had vivid experiences of the sort they call spiritual or supernatural tended to receive higher scores on the Absorption Scale (Tellegen & Atkinson, 1974), *which appeared to be a measure of an individual's interest and skill in being caught up in one's imagination and in immersive experience. I ran a training study, randomizing people into lectures on the gospels and into imaginative prayer practice, and I found that the prayer practice also led to more vivid spiritual experiences. In* When God Talks Back (2012), *I demonstrated that there was some kind of story to tell about the way intense attention to inner experience leads to some inner phenomena feeling more external, more in-the-world real. There was something about the way people imagined their minds, and paid attention to their minds, that really mattered.*

I began to collaborate closely with Kara Weisman, a psychologist, when I was funded to carry out the Mind and Spirit Project, a large comparative project that lay the foundation for the findings described in this manuscript. She has taken the lead in addressing these questions with quantitative methods and statistical analyses. It seemed appropriate to have her lead this essay for cognitive scientists by presenting our latest findings.

Our collaboration has implications for cognitive science. Perhaps the most striking lesson for most cognitive scientists is that ethnography is extremely valuable. A long time spent in close and careful observation of the phenomena that puzzle you changes the way you understand the puzzle. It provides an expertise that other methods do not, leading to strong hypotheses that can be articulated clearly and tested robustly; in our case, these hypotheses, grounded in decades of ethnographic work, have proved to be quite accurate predictions of which people, in which settings, are most likely to report vivid spiritual experiences (as we detail in the following sections). And combining ethnography with other methods reshapes the way the ethnographer understands her data. For myself, coming across the Absorption Scale changed the conversations I was having about why practitioners said that some people were better than others. And in finding the scale, I then had other puzzles, like the puzzle of what, precisely, the scale actually captured. It had seemed clear to me in my first ethnographic work on evangelical Christians that when people were new to the church, they had to learn that some thoughts that felt like their own were actually God speaking to them—and that their minds were in this way "porous" to God. In the large comparative project, we developed a "porosity" scale (first drafted by the anthropologist John Dulin) to capture some of these themes—and the porosity scale also predicted whether people had vivid experiences of gods and spirits. Now we had a deep intellectual puzzle that emerged from the statistical side of the research, which is how absorption was related to porosity. This is the puzzle at the heart of this paper.

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It is a testimony to the remarkable strength of this interdisciplinary enterprise we call cognitive science that it includes us, embraces us, and pushes us forward.

1. Background for the current paper

Spiritual experiences have received little attention from cognitive scientists, despite growing interest in other aspects of religious cognition, such as concepts of religious beings (e.g., Barrett, 2004; Boyer, 2008; Lang et al., 2019; Norenzayan, 2013; Willard & McNamara, 2019) and the nature of religious beliefs in relation to other kinds of moral and epistemic attitudes (e.g., Rozin, Berman, & Royzman, 2010; Singh, 2021; Van Leeuwen, 2014; Van Leeuwen, Weisman, & Luhrmann, 2021; Willard, Baimel, Turpin, Jong, & Whitehouse, 2020; Willard & Norenzayan, 2013). In our view, however, phenomenal experiences of immaterial spiritual beings are a useful (and largely unexplored) resource for the field of cognitive science because they are in some sense experiences *of the mind*, tied to models and cognitive-epistemic attitudes *about the mind*. These events—such as hearing the voice of God or seeing the spirit of an ancestor—are examples of how, with the right combination of mental models and cognitive-epistemic attitudes, one's own thoughts and inner sensations can be experienced as coming from somewhere or someone else.

In this paper, we present results from a large-scale study of U.S. adults that, together with previous work, deepens and refines our understanding of the cognitive mechanisms that give rise to spiritual presence events. We argue that moments when, for example, a thought in one's mind feels like it comes from a supernatural source, or even is heard as if someone else were speaking it out loud, are facilitated by a dynamic interaction between mental models and cognitive-epistemic attitudes: A person is more likely to hear God speak if they have the epistemic flexibility and cultural support to shift, temporarily, away from a mundane model of mind into a more "porous" way of thinking and being. We conclude with a meditation on how mental models and cognitive-epistemic attitudes might also interact to facilitate other phenomena of interest to cognitive science, such as fiction writing and scientific discovery.

1.1. Spiritual presence events and the Mind and Spirit Project

To date, the main empirical evidence for our claims about spiritual presence events has come from the Mind and Spirit Project, a multi-year study across diverse religious groups in five countries (from west to east: the United States, Ghana, Thailand, China, and Vanuatu). This was a comparative, interdisciplinary project drawing on the expertise of anthropologists, psychologists, historians, and philosophers to explore whether different understandings of "mind," broadly construed, might shape the ways that people attend to and interpret experiences they deem spiritual, religious, or supernatural. We took a mixed-method, multi-phase approach, combining participant observation, long-form semi-structured interviews, quantitative surveys among the general population and local undergraduates, and psychological experiments with children and adults; the majority of data collection took place between 2017 and

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2019. In each of the five countries represented in this work, we worked in both urban and rural settings, with participants from charismatic evangelical Christian churches and with participants engaged in some other religious tradition of local importance (including other varieties of Christianity, Buddhism, and a range of traditional indigenous religious practices).[1] For ethnographic and methodological insights from this project, see Aulino (2020), Brahinsky (2020), Dulin (2020), Dzokoto (2020), Luhrmann (2020b, 2020c), Ng (2020), Smith (2020), and Weisman and Luhrmann (2020). For empirical results, see Luhrmann, Weisman, et al. (2021b), Schille-Hudson, Weisman, and Luhrmann (2024b), Van Leeuwen et al. (2021), and Weisman et al. (2021).

The Mind and Spirit Project focused on what we call "spiritual presence events": experiences like hearing the voice of God, seeing ancestors and other spirits or otherwise sensing the presence of or communication from an immaterial spiritual being. We do not attempt to address ontological questions about the reality status of the spiritual beings under discussion, but we take seriously people's reports of having had such sensory or quasi-sensory experiences. In much of our work, we have gone to great lengths to establish the precise nature and texture of each of these phenomenal experiences, asking people to describe, for example, whether they heard a voice in their mind or with their ears, whether they turned their head to see where it was coming from, what the voice sounded like, how they knew it was the voice of God, and so on (an interviewing method that we have called "comparative phenomenology"; see Luhrmann et al., 2021b). In some cases, this line of questioning has allowed a participant to clarify that what they are discussing is more of a theological belief about God, or a general feeling of closeness with God—but in many cases, these questions have yielded a clear picture of a particular phenomenal experience with what we take to be genuine cognitive, emotional, and sensory content. From this work and from the vast ethnographic record, we are confident that spiritual experiences are not just figures of speech: Many people have had thoughts, emotions, or auditory, visual, tactile, or other sensations that they understand to be experiences of an immaterial presence.

One hallmark of such events is that they stand out to the perceiver, in the moment, as coming from someone or somewhere beyond the self: A thought pops into my mind and it feels as though it is not my own; I hear someone else's voice coming from behind me even though I am the only person in the house. Such experiences have something in common with the hallucinations common among people with psychosis (Moseley & Mitrenga, 2022), but they are typically not disruptive or distressing to those who have them—and they are far from "abnormal." In fact, such experiences are far more common among the general public than many people realize (Posey & Losch, 1983; Schille-Hudson et al., 2024b; Tien, 1991).

How is it that so many people come to have such experiences? The empirical results of the Mind and Spirit Project, together with the many years of anthropological work that preceded them (Luhrmann, 1989b, 2012, 2020a), have yielded a substantial amount of evidence that two key factors facilitate such spiritual presence events: *porosity* and *absorption*. (More recently, we have argued that a third factor, prayer practice, also facilitates these events, but we will not discuss that here; see Schille-Hudson, Weisman, & Luhrmann, 2024a). Both porosity and absorption are ways that people understand and experience their own minds.

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1.2. Porosity: Beliefs about the mind

The first factor is *porosity*, the idea that to some extent, in some ways, the boundary between mind and world is permeable. The term "porosity" is inspired by the work of the philosopher Charles Taylor, who uses the concept of a "porous" or "permeable self" as a foil to his description of the "bounded self"—an interior mental space cordoned off from the exterior world—which he claims is pervasive in modern secular societies (Taylor, 2007). We have adopted the term "porosity" to describe a common feature of mental models of the mind across diverse cultural settings (including secular Western settings, as we return to in the current study): an understanding that the boundary between mind and world is perhaps, under certain circumstances, permeable; that thoughts, emotions, desires, knowledge, and other mental content might occasionally pass from mind to world or world to mind in ways that violate ordinary "laws" of perception and action.

We suggest that most people in most settings default to assuming the mind is bounded: Most people's everyday behaviors are consistent with a model of mind in which thoughts are private, originate inside the thinker, and never slip into the world to act on their own.

And yet even ordinary phenomenal experience of mental events gives rise to experiences that seem to contradict that default model. Sometimes people feel that others—perhaps especially a mother, or a sibling—know what they are thinking, even when they are far away or when they do their best to hide it. People dream, and powerful dreams sometimes feel as if they contain information from elsewhere. When people curse, it can feel like an action that will affect the world directly. We will call these contradictions of bounded expectations "porous." Example of porous intuitions that have been documented empirically among secular Westerners include the idea that wishes might come true if they are made in the right way (e.g., Woolley, Phelps, Davis, & Mandell, 1999), the sense that anger might linger in a room after an argument even after the people have left (e.g., Savani, Kumar, Naidu, & Dweck, 2011), and the reluctance to board a plane the morning after a dream about a plane crash (e.g., Morewedge & Norton, 2009). Notions of a porous mind-world boundary are pervasive in many spiritual and religious traditions: Prayer, curses, ritual, spirit possession, and afterlife beliefs are all examples of phenomena that hinge on the possibility that certain kinds of mental content—desires, intentions, motivations, personalities—can enter or exit the mind via supernatural or non-ordinary means (e.g., Cruz, 2015; Evans-Pritchard, 1937; Haynes, 2017; Johnston, 1999; Lambek, 1981; Legare & Gelman, 2008; Lohmann, 2019; West, 2008).

In the Mind and Spirit Project, we developed two quantitative measures of porosity (Porosity Vignettes and the Porosity Scale), based directly on ethnographic observations from the field, and we employed these measures in four quantitative studies of the predictors of spiritual presence events. In all cases, participants' responses to our questions about porosity were positively related to their reports of spiritual presence events, both within and across cultural-religious settings (Luhrmann et al., 2021b).

In subsequent theoretical work, we have elaborated on the idea that porosity is a dimension of variability in cultural models (or "folk theories") of the mind (Luhrmann & Weisman, 2022). Drawing on ethnographic evidence (Descola, 2013; Lienhardt, 1961; Luhrmann, Weisman, et al., 2021b; Vilaça, 2005), we have claimed that across cultural settings, models

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of mind vary substantially in the degree to which the mind-world boundary is understood to be permeable, and in the ways in which it might or might not be crossed: from inside to outside, as in mental messages and prayers; from outside to inside, as in premonitions and spirit possession; through certain actions, like rituals; through certain forms of speech, like curses; or by extraordinary people, such as a spirit mediums, prophets, witches, or psychics. At the same time, we argue, all humans have access both to a "bounded" model of the mind and to some more porous model (although the degree and nature of this porosity vary across settings). Local cultural ideas build on and elaborate the contradictions between porous intuitions and this default bounded model, so that—under some conditions—thoughts are understood to escape the body, enter into other people's minds and bodies, and act with supernatural force (according to the local folk theory of mind).

In other words, we argue that all people have conflicting intuitions about the nature of the boundary between mind and world (Luhrmann & Weisman, 2022). However, our previous studies have been too small to provide empirical descriptions of cultural variability across different models of mind that we would classify as porous and too small to provide evidence of conflicting intuitions about porosity and boundedness within an individual participant.

1.3. Absorption: Experiences of the mind

The second factor that we have found to facilitate spiritual presence events is *absorption*, which we have characterized as an immersive orientation toward one's own mind and experience (Luhrmann et al., 2021b).

The construct of absorption comes from the work of the personality psychologist Auke Tellegen, who set out to develop an inventory of personal characteristics that predict hypnotizability. The resulting Absorption Scale (Tellegen & Atkinson, 1974) is now a widely used measure in the fields of social and personality psychology, psychiatry, and media studies, where it has been shown to correlate not only with hypnotic susceptibility but also with daydreaming, mind-wandering, and fantasy-proneness (Crawford, 1982; Hoyt et al., 1989; Lynn & Rhue, 1986, 1987, 1988; Råmonth, 1985; Rhue & Lynn, 1989; Rivers, Wickramasekera, Pekala, & Rivers, 2016), general abilities in the domain of mental imagery (Campos & Pérez, 1988; Crawford, 1982; Hilgard, Sheehan, Monteiro, & Macdonald, 1981; McConkey & Nogrady, 1986; Monteiro, MacDonald, & Hilgard, 1980; Sheehan, McConkey, & Law, 1978; Spanos, McPeake, & Churchill, 1976, 1987; Sweeney, Lynn, & Bellezza, 1986), and a wide range of other phenomena (see Lifshitz, van Elk, & Luhrmann, 2019; Roche & McConkey, 1990).

Many people experience some degree of absorption when they read a story or watch a movie: They identify with the characters or get carried away by the plot; they might even feel as though they have been transported into a different world, only to look up at the end of the book or the film to find that time has passed without them realizing (Nell, 1988). For others, a state of absorption might be familiar from making art, playing music, swimming laps, or walking through nature. For many people, such moments are fleeting, but these tendencies vary substantially across individuals (Tellegen, 1981). And as we and our collaborators have noted, there is also a motivational component to absorption: People vary not only in their ten-

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dency or ability to become engrossed by and immersed in sensory or imaginative experiences but also in their willingness to enter into such a state (see Lifshitz et al., 2019).

There are many religious and spiritual practices that make use of the ability to enter into a state of absorption: Meditation, chanting, dancing, and prayer are all examples of behaviors that encourage people to immerse themselves in their own sensory experiences and their own inner lives (Cassaniti, 2015; Cook, 2010; Rouget, 1985). We and our collaborators have also found the Absorption Scale to be a robust predictor of religious and spiritual experience as well as more secular extraordinary experiences, such as paranormal and psychedelic experiences (see Lifshitz et al., 2019, for a comprehensive review). In the Mind and Spirit Project, we found that, within and across cultural-religious settings, participants' responses to the Absorption Scale were positively related to their reports of spiritual presence events (Luhrmann et al., 2021b).

In subsequent theoretical work, we have proposed that the Absorption Scale might pick up on two distinct aspects of individual differences that facilitate spiritual experience: (1) the ability to suspend reality testing and have experiences without immediately assessing their reality status and (2) a capacity for vivid mental imagery, that is, a sensorially rich inner world (Luhrmann & Weisman, 2022). (See also Luhrmann et al., 2021a, for some preliminary empirical support for this proposal.)

1.4. What is the relationship between porosity and absorption?

The Mind and Spirit Project yielded robust evidence that these two factors, porosity and absorption, are robust predictors of which people, in which cultural-religious settings, are most likely to report having experienced more spiritual presence events. Of all the things that might play a role in the experience of spiritual presence events, why these two factors?

One reason is that spiritual experiences are rooted in experiences of one's own mind (experiences that come to feel "not me" to those who experience them), and both porosity and absorption describe the way people relate to their own minds. Porosity is a kind of belief about how the mind works, and absorption is a kind of orientation or attitude toward one's own mind and experiences. What distinguishes them is that porosity is more "cultural" and more "cognitive," while absorption is more "individual" and more "affective"—that is, one learns from one's community how to represent and reason about the mind and the mind-world boundary and combines this cultural model with one's personal style of attending to and experiencing the world (including one's own mind).

There may also be a deeper, more specific connection between porosity and absorption: A capacity for absorption might allow a person to engage more vividly with more porous ways of understanding the mind and the world, and to do so with less skepticism, that is, with less concern about testing the reality of any experiences that might ensue (Luhrmann & Weisman, 2022). If this is indeed the case, we would expect that access to more porous models of the mind-world boundary would have particularly strong effects among the individuals who are more able to engage more deeply with this alternative worldview—in other words, that we would observe a positive interaction between porosity and absorption in their effect of reports of spiritual experience. In our previous work, we have not detected such a statistical

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interaction (Luhrmann et al., 2021b), but due to the relatively modest sample sizes of our previous studies, we do not take this as strong evidence for the absence of an interactive relationship between porosity and absorption. The possibility of exploring such an interaction was one of the primary motivations for conducting the current study.

1.5. The current study

In this paper, we describe a replication study of the key quantitative evidence that has informed the theory just described (Luhrmann et al., 2021b), conducted in a large enough sample ($N = 1779$) of U.S. adults to enable new, in-depth analyses of porosity, absorption, and the potential interaction between them.

The current study was designed to be a direct replication of Study 4 in Luhrmann et al. (2021b). Following the results reported in that paper, we made four predictions (preregistered at https://osf.io/3uygk/): (1) Porosity is a significant positive predictor of spiritual presence events. (2) Absorption is a significant positive predictor of spiritual presence events. (3) Porosity and absorption are distinct predictors of spiritual experience. That is, scores on our indices of porosity and absorption will both remain significant positive predictors of spiritual presence events after statistically controlling for each other in a single model. (4) Porosity and absorption are stronger predictors of spiritual experience than two "control" measures, the Need for Cognition scale (Cacioppo & Petty, 1982) and Sense of Control: Mastery subscale (Lachman & Weaver, 1998).

In addition, as described in the previous section, a primary exploratory aim of the current study was to conduct a well-powered investigation of possible statistical interactions between porosity and absorption (see preregistration). To facilitate a well-powered investigation of this potential interactive relationship, we turned to the online survey platform Prolific to recruit a larger sample than we could reasonably hope to recruit in the kind of multi-site, mixed-method, in-person fieldwork that has formed the backbone of our previous studies.

The size of this sample also enabled more nuanced, item-wise explorations of our measures of porosity and absorption, shedding new light on the ways in which these factors facilitate spiritual presence events.

2. Methods

2.1. Measures

The current study was a direct replication of Study 4 in Luhrmann et al. (2021b). See Table 1 for example items from all of the measures used in this study, and see Luhrmann et al. (2021b), Supporting Information, "Study 4," for the full list of items for all of the survey measures included in this study.

Participants completed two measures of spiritual presence events: the Spiritual Events scale and the Daily Spiritual Experiences scale. The Spiritual Events scale (Luhrmann et al., 2021b) consisted of 22 events; participants reported how frequently they experience these events

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Table 1
Example items from all measures included in the current study

Measure	Example Items
Spiritual Events scale (Luhrmann et al., 2021b)	*Have you ever heard God or a spirit speak to you in a voice you felt you heard outside your head?* *Have you ever felt that a supernatural force, like the Holy Spirit or a demon, took control of your body, so that you were not making the choice of whether to move but still you moved?*
Daily Spiritual Experience scale (Underwood & Teresi, 2002)	*I feel God's presence* *I ask for God's help in the midst of daily activities*
Hallucinations scale (Morrison et al., 2000)	*I hear a voice speaking my thoughts aloud* *I have had the experience of hearing a person's voice and then found that there was no one there*
Paranormal scale (Thalbourne & Delin, 1993)	*I am completely convinced that ESP exists* versus *I am completely convinced that ESP does not exist* *I am completely convinced that I have had at least one dream that came true and which (I believe) was not just a coincidence* versus *I am completely convinced that I have never had a dream that came true and which (I believe) was anything other than a coincidence*
Porosity Vignettes scale (Luhrmann et al., 2021b)	*Suppose that in a distant community that is very much like this one, there is a woman named Jane. One day, Jane realizes that her neighbor Mary is really, really angry at her, and she has been angry for a long time… Suppose Jane got sick after Mary got angry with her. Do you think Mary's anger could be the cause?* *One day, Barbara realizes that her neighbor Sarah feels a very, very strong sense of caring and responsibility for her, and she has felt this caring and responsibility for a long time… Let's say Barbara is sick, but Sarah can't visit or phone her. If Barbara* [sic] *thought good thoughts about Sarah* [sic] *every day, would that help to make her well?* *One day, Joanne realizes that her neighbor Martha is really, really envious of her, and she has been envious for a long time… Could Martha hurt Joanne just by thinking envious thoughts about her?*
Porosity Scale (Luhrmann et al., 2021b)	*Evil thoughts can go out into the world like Wi-Fi or a radio and cause bad things to happen to other people* *Spirits can read our thoughts and act on them even if we don't speak them out loud*
Absorption scale (Tellegen & Atkinson, 1974)	*Sometimes I feel and experience things as I did as a child* *When I listen to music I can get so caught up in it that I don't notice anything else*
Need for Cognition scale (Cacioppo & Petty, 1982)	*I prefer complex to simple problems* *Thinking is not my idea of fun. (reversed)*
Sense of Control "Mastery" subscale (Lachman & Weaver, 1998)	*I can do just about anything I really set my mind to* *There is little I can do to change many of the important things in my life. (reversed)*

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on a 5-point Likert-type scale from "never" to "very often," with the additional response options of "I don't know" and "I prefer not to answer" (both coded as missing data), and responses were averaged to create scores ranging from 0 to 4 (observed Cronbach's $\alpha = 0.93$). The Daily Spiritual Experience scale (Underwood & Teresi, 2002) consisted of 14 events; participants indicated how frequently they have these experiences on a 6-point Likert-type scale from "never" to "many times a day," with the additional response option of "I prefer not to answer" (coded as missing data). Following Luhrmann et al. (2021b), we omitted two non-experiential items from our administration of the Daily Spiritual Experience scale (*I desire to be closer to God or in union with God*; *in general, how close to you feel to God?*). Responses were averaged to create scores ranging from 0 to 5 (observed Cronbach's $\alpha = 0.96$). For these two outcome measures, and for all of the additional outcome and predictor measures described below, participants' scores were standardized prior to being entered into analyses.

In addition to these measures of spiritual experience, participants also completed two measures of extraordinary secular experiences: the Hallucinations scale and the Paranormal scale. The Hallucinations scale (an abbreviated, revised version of the Launay–Slade scale; Morrison, Wells, & Nothard, 2000) consisted of six events; participants reported how frequently they experience these events on a 4-point Likert-type scale from "never" to "almost always," with the additional response option of "I prefer not to answer" (coded as missing data); responses were averaged to create scores ranging from 0 to 3 (observed Cronbach's $\alpha = 0.80$). The Paranormal ("Sheep-Goat") scale (Thalbourne & Delin, 1993) consisted of seven pairs of statements; participants were instructed to select the choice that best corresponded with their opinion, with the additional response option of "I prefer not to answer" (coded as missing data); items phrased in the negative (e.g., "does not exist"; "have never had") were scored as 0, and items phrased in the positive ("exists"; "have had") were scored as 1, and responses were averaged to create scores ranging from 0 to 1 (observed Cronbach's $\alpha = 0.88$).

In terms of our key predictors, participants completed two measures of porosity: the Porosity Vignettes scale and the Porosity Scale. The Porosity Vignettes scale (Luhrmann et al., 2021b) consisted of three vignettes about strong feelings and their potential supernatural potency; one vignette focused on anger, one on caring, and one on envy. Each vignette was followed by four to five questions about how the story might proceed. Due to an experimenter error, the names Barabara and Sarah were inadvertently switched in one item about the power of caring (it should read, *If Sarah thought good thoughts about Barabara every day…*), and there was one item in the vignette about envy that referred to "anger" instead of "envy" (*If Joanne fell ill, could Martha's anger be the cause?*); we retained these items in the calculation of Porosity Vignettes scores because, despite these errors, the questions still probed intuitions about the boundary between mind and world. Altogether, the scale included 14 multiple-choice questions, and participants reported how frequently each event might happen on a 4-point Likert-type scale from "never" to "very often," with the additional response option of "I prefer not to answer" (coded as missing data). Following Luhrmann et al. (2021b), we omitted three items about the effects of emotions on one's own body from our calculation of Porosity Vignettes scores (e.g., *Do you think Mary's anger can make Mary sick or well? In other words, can her feeling affect her physically?*). Responses to the remaining items

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were averaged to create scores ranging from 0 to 3 (observed Cronbach's $\alpha = 0.95$). The Porosity Scale (first drafted by the anthropologist John Dulin; see Luhrmann et al., 2021b) consisted of 14 statements; due to experimenter error in constructing the Qualtrics survey, two additional items that were included in the Porosity Scale in our previous work were omitted from this study: *There are some people who can truly consult with (or otherwise connect with) the unseen and answer questions for people*, and *There are some people who can curse other people and make them sick or otherwise affect their mind or body*. The resulting scale still demonstrated high internal consistency (Cronbach's $\alpha = 0.94$) and behaved as predicted (see "Results"), so we proceeded as planned with the resulting 14-item scale. Participants judged the likelihood of each statement using the following response options: "It does not happen," "It might happen," or "It definitely happens," with the additional response option of "I prefer not to answer" (coded as missing data). For six of these statements, participants also answered follow-up questions about whether they had heard of this happening to people they know, whether they were worried about it happening to them, and whether they did anything to protect themselves against it; following Luhrmann et al. (2021b), these questions did not factor into Porosity Scale scores.

Participants completed one measure of absorption: The Absorption scale (Tellegen & Atkinson, 1974). The scale consisted of 34 statements; participants indicated their agreement with these statements by selecting either "true" or "false," with the additional response option of "I prefer not to answer" (coded as missing data); responses were averaged to create scores ranging from 0 to1 (observed Cronbach's $\alpha = 0.91$).

Beyond our key outcomes and predictors, participants completed two "control" measures that we hypothesized would be less predictive of spiritual presence events than our indices of porosity or absorption: the Need for Cognition scale and the Sense of Control "Mastery" subscale. The Need for Cognition scale (Cacioppo & Petty, 1982) consisted of 18 statements; half (nine) of these statements were reverse-coded. Participants indicated their identification with these statements using a 5-point Likert-type scale from "extremely not like me" to "extremely like me," with the additional response option of "I prefer not to answer" (coded as missing data); responses were averaged (after reverse-coding) to create scores ranging from -2 to 2 (observed Cronbach's $\alpha = 0.95$). The Sense of Control "Mastery" subscale (Lachman & Weaver, 1998) consisted of 12 statements; one third (4) of these statements were reverse-coded. Participants indicated their agreement with these statements using a 7-point Likert-type scale from "strongly disagree" to "strongly agree," with the additional response option of "I prefer not to answer" (coded as missing data); responses were averaged (after reverse-coding) to create scores ranging from -3 to 3 (observed Cronbach's $\alpha = 0.92$). Following Luhrmann et al. (2021b), we will present key analyses including these two control scales both with the subset of reverse-coded items included and with them excluded.

Participants were randomly assigned to complete the survey measures in one of two orders, matched to the two orders employed in the original study: (1) Porosity Scale, Porosity Vignettes, Hallucinations, Paranormal, Sense of Control: Mastery, Daily Spiritual Experiences, Spiritual Events, Need for Cognition, Absorption; or (2) Absorption, Daily Spiritual Experiences, Spiritual Events, Sense of Control: Mastery, Hallucinations, Paranormal, Need for Cognition, Porosity Scale, Porosity Vignettes. At the end of the study, participants

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completed some questions about their sleep habits and their religious affiliation and practices and a variety of demographics questions.

2.2. Data preparation

Internal consistency for the measures included in this study was uniformly high (see Supporting Information, "Results: Section 4," for a full analysis). Even the scales with the lowest observed reliability exceeded traditional benchmarks (Hallucinations scale: Cronbach's $\alpha = 0.82$; Paranormal scale: $\alpha = 0.88$; for all other measures, $\alpha \geq 0.90$). Thus, following our preregistration, we calculated average "scores" for each measure, including participants regardless of item-wise missing data.

Unless otherwise noted below, all categorical variables were effect-coded for comparison to the grand mean, and all continuous variables were standardized before being entered into analyses.

Analysis and visualization code is provided in the Supporting Information, along with extended results. Primary analyses relied on the following R packages: tidyverse (v2.0.0, Wickham et al., 2019), lme4 (v1.1-35.3, Bates, Maechler, Bolker, & Walker, 2015), parameters (v0.21.6, Lüdecke, Ben-Shachar, Patil, & Makowski, 2020), psych (v2.3.3, Revelle, 2023), and langcog (v0.1.9001, Braginsky, Yurovsky, & Frank, 2023).

2.3. Participants

Participants were recruited through the online survey platform Prolific and were paid $8.25 for their time; the median duration of the survey was 27 min, and 78% of participants submitted their responses within 40 min of beginning the survey. All participants completed the study between December 9 and 13, 2022.

2.3.1. Inclusion and exclusion

To be eligible for the study, participants were required to be at least 18 years old, to be located in the United States, to have reported being fluent in English (on a Prolific pre-screener question), and not to have participated in any of our previous pilot studies related to this study. We used the survey administration options provided by Prolific to limit the study to U.S. participants and to achieve a rough balance between participants who identified as men versus women.

We aimed to include a substantial number of participants who self-identified as spiritual or religious. Following our preregistration, we recruited the first 75% of our planned sample with no religion screener, then checked responses to a demographic question about religious affiliation; because at least 50% of that initial sample identified as spiritual or religious, we completed recruitment using the same inclusion criteria described above without implementing any additional inclusion criteria.

We preregistered and implemented four exclusion criteria to ensure high-quality data (particularly given the unsupervised nature of data collection via Prolific): we excluded 18 participants who failed two or more of the three "attention check" questions embedded in the survey

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(e.g., *To demonstrate that you are human and are paying attention, please select "it definitely happens"*); 28 participants who provided nonsensical or non-English responses to a comprehension question included at the very end of the survey; 1 participant who indicated in a self-assessment of data quality that they did not provide thoughtful answers to our questions; and 22 participants who completed the survey in under 10 min. Because some participants were excluded for more than one reason, this yielded a final dataset of $N = 1779$.

2.3.2. Demographics

The overwhelming majority (88%) of participants reported having been born in the United States. Nearly all states (49/50) and the District of Columbia were represented in participants' self-reported current zip codes, with 41% residing in the South, 22% in the Midwest, 19% in the West, and 18% in the Northeast (as defined by the U.S. Census Bureau); 1% of participants declined to answer this question. Participants ranged in age from 18 to 85 years (median age: 37 years). By design, the sample included roughly equal numbers of women (49%) and men (49%), with an additional 2% of participants identifying as some other gender. The majority of participants (63%) identified as White; 17% identified with more than one race/ethnicity, 8% as Black or African American, 4% as Hispanic or Latina/o, 3% as East Asian, 2% as Southeast Asian, 1% as South Asian, and <1% identified with any other race/ethnicity or declined to answer this question. The majority (60%) of participants had obtained at least a college degree; an additional 36% had obtained at least a high school degree. Self-reports of financial security/precarity varied across the sample, with the modal participant reporting that they had either "Just enough" to pay their family's regular expenses (26%) or "Some money left over" after paying their family's regular expenses (36%), and 65% of participants indicating that they see themselves in the mid-range on the McArthur scale of subjective social status (i.e., between 4 and 7 on a scale of 0–10; Adler, Epel, Castellazzo, & Ickovics, 2000).

In terms of religious identity, affiliation, and practices, our sample included roughly equal numbers of Christians ($n = 768$, 43% of total sample) and non-religious participants ($n = 702$, 39% of total sample). Among Christians, 29% identified as Catholic and no other faith ($n = 219$, 12% of total sample); 27% as Protestant and no other faith ($n = 208$, 12% of total sample); 21% as Christian with no specific denomination ($n = 160$, 9% of total sample); 16% as Evangelical or "born again," sometimes in combination with other Christian denominations ($n = 120$, 7% of total sample); and ≤2% ($n \leq 18$, ≤1% of the total sample) were affiliated with any other specific variety of Christianity (e.g., members of traditionally Black churches, Jehovah's Witnesses, members of the Church of Jesus Christ of Latter-day Saints) or reported more than one (non-Evangelical) Christian identity. Among non-religious participants, 40% identified exclusively as agnostic ($n = 282$, 16% of total sample); 38% exclusively as atheist ($n = 264$, 15% of total sample); 16% exclusively as "nothing in particular" ($n = 111$, 6% of total sample); and 6% ($n = 45$, 3% of total sample) identified with more than one of these non-religious designations.

Beyond Christian and non-religious participants, an additional 6% of the total sample ($n = 102$) identified exclusively as "Spiritual but not religious"; 3% ($n = 60$) identified as a member of another world religion (primarily Judaism: $n = 25$); and a further 6% of the total

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sample ($n = 103$) identified with more than one religious/spiritual identity (e.g., both Catholic and agnostic; both Christian and "Spiritual but not religious"; both Jewish and atheist; both Buddhist and Hindu). Two percent of the total sample ($n = 30$) identified with any other individual religious/spiritual identity (e.g., Paganism) or declined to answer this question.

3. Results

3.1. Replication of previous results

The current study was a direct replication of Luhrmann et al. (2021b, Study 4), and all analyses were direct analogs of the analyses reported in that paper. (For the complete results of all regression models reported here, see Supporting Information, "Results: Section 1.")

We first tested the hypotheses that porosity and absorption were each distinct, positive predictors of spiritual presence events (see preregistered Hypotheses #1–3). Mixed-effects linear regressions taking into account variability across measures of spiritual presence events confirmed that Porosity Scale score was a positive predictor of spiritual presence events ($\beta = 0.61$ [95% CI: 0.58, 0.64], $t = 38.40$, $p < .001$) as were Porosity Vignettes score ($\beta = 0.50$ [0.46, 0.53], $t = 27.70$, $p < .001$) and Absorption score ($\beta = 0.35$ [0.31, 0.38], $t = 17.42$, $p < .001$). See Fig. 1. Porosity Scale and Absorption scores remained significant predictors of spiritual presence events after statistically controlling for each other in a single model, and likewise for Porosity Vignettes and Absorption scores (main effects of Porosity Scale: all βs ~0.54, all ts>29.96, all ps $< .001$; main effects of Porosity Vignettes: all βs ~0.40, all ts $>$ 19.14, all ps $< .001$; main effects of Absorption: βs ranged from 0.13 to 0.20, all ts > 8.66, all ps $< .001$).

As in our previous work, these relationships were very similar when considering the two indices of secular extraordinary experiences in place of spiritual presence events: Scores on our two indices of secular extraordinary experiences were positively related to Porosity Scale scores ($\beta = 0.48$ [0.45, 0.51], $t = 29.5$, $p < .001$), Porosity Vignettes scores ($\beta = 0.46$ [0.43, 0.50], $t = 28.26$, $p < .001$), and Absorption scores ($\beta = 0.45$ [0.42, 0.49], $t = 27.34$, $p < .001$), and both porosity and absorption remained significant predictors after statistically controlling for each other and after taking into account variability across measures of secular experiences (main effects of Porosity Scale: βs ranged from 0.34 to 0.35, all ts > 20.39, all ps $< .001$; main effects of Porosity Vignettes: βs ranged from 0.34 to 0.35, all ts > 19.21, all ps $< .001$; main effects of Absorption: βs ranged from 0.31 to 0.32, all ts > 19.37, all ps $< .001$). See Fig. 1.

Finally, we tested the hypothesis that porosity and absorption are stronger predictors of spiritual experience than our two control measures (the Need for Cognition scale and the Sense of Control: Mastery subscale; see preregistered Hypothesis #4). As predicted, compared to these control measures, porosity and absorption were significantly stronger predictors of spiritual presence events, both when indexed by the Spiritual Events scale (all βs ~0.11, all ts $>$ 27.80, all ps $< .001$) and when indexed by the Daily Spiritual Experience scale (all βs ~0.10, all ts > 24.17, all ps $< .001$); this remained true when reverse-coded items were omitted from

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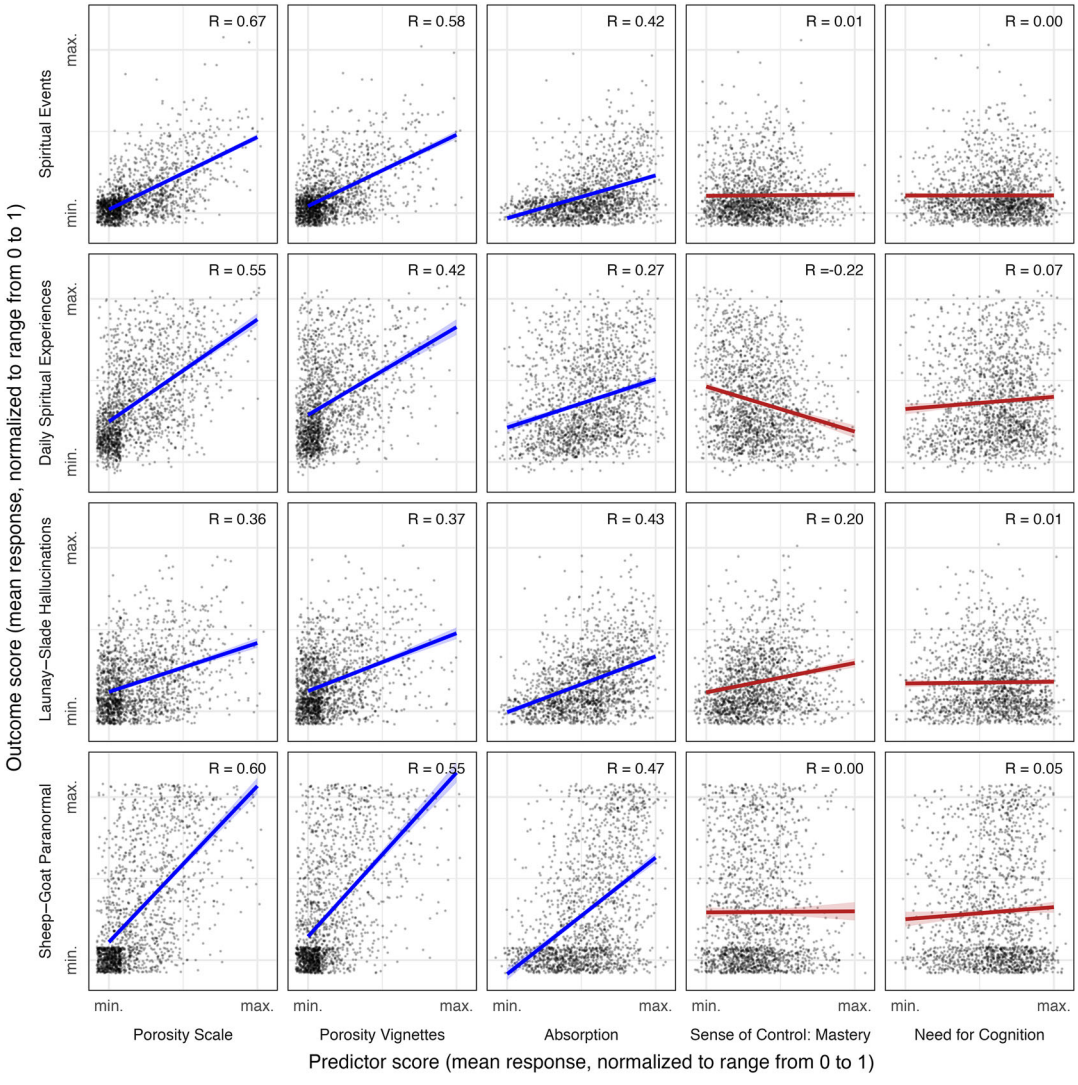

Fig. 1. Porosity and absorption were positively correlated both with spiritual presence events and with secular extraordinary experiences and more strongly correlated with these outcomes than were control measures. The plot depicts relationships between predictors (predictors of interest, in blue: Porosity Scale scores, Porosity Vignettes scores, and Absorption scores; control predictors, in red: Need for Cognition scales and Sense of Control: Mastery subscale scores) and outcomes (spiritual presence events, top two rows: Spiritual Events scores, Daily Spiritual Experiences scores; secular extraordinary experiences, bottom two rows: Hallucinations scores and Paranormal scores) among all participants included in the current study ($N = 1779$). Small dots represent individual participants; smoothed lines represent simple linear regressions. For the purposes of this visualization, scores on all measures normalized to range from 0 (marked as "min.") to 1 (marked as "max.").

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analyses (βs ranged from 0.09 to 0.10, all ts > 22.76, all ps < .001). This was also true for our two measures of secular extraordinary experiences, the Hallucinations scale (βs ranged from 0.05 to 0.06, all ts > 13.19, all ps < .001; omitting reverse-coded items, all βs ~0.04, all ts > 10.88, all ps < .001) and the Paranormal scale (all βs ~0.10, all ts > 25.65, all ps < .001; omitting reverse-coded items, βs ranged from 0.09 to 0.10, all ts > 23.49, all ps < .001). Again, these findings closely parallel our previous results.

In sum, we consider this a strong replication of our previous findings: Porosity and absorption were strong predictors of spiritual presence events, regardless of people's participation in a particular religion and regardless of how we assessed these relationships. These two factors played distinct roles in determining which participants were most likely to report experiencing extraordinary experiences (of either a religious or secular nature), and they were better predictors than other less theoretically motivated constructs.

3.2. Assessing the interaction between porosity and absorption

One of the primary aims of the current study was to conduct a well-powered investigation of possible statistical interactions between porosity and absorption. The analyses we used to assess whether porosity and absorption played distinct roles in predicting extraordinary experiences also serve this purpose.

These analyses consistently yielded evidence in favor of the positive interaction that would align with our recent theoretical work (Luhrmann & Weisman, 2022): In each regression model, above and beyond the positive effects of porosity and absorption (and after statistically controlling for any differences across age, gender, and our two spiritual presence measures), we observed a significant positive interaction between porosity and absorption (βs ranged from 0.05 to 0.06, all ts > 3.08, all ps < .003). Significant three-way interactions with outcome suggested that the interaction between porosity and absorption was particularly pronounced for Spiritual Events scores, the more "experiential" of our two measures of spiritual presence events (βs ranged from 0.05 to 0.09, all ts>4.62, all ps < .001).

See Fig. 2, top row, for a visualization of the interaction between Porosity Scale scores and Absorption scores (and see Supporting Information, Fig. S01, for an analogous plot of the interaction between Porosity Vignettes scores and Absorption scores). Among participants who endorsed fewer than 25% of the items on the Absorption scale (top row, leftmost panel), Porosity Scale scores were a positive predictor of both indices of spiritual presence events (correlation with Spiritual Events scores: R = 0.52; with Daily Spiritual Experiences scores: R = 0.36), but these positive relationships were stronger among participants who endorsed more of the items on the Absorption scale, and strongest among participants who endorsed more than 75% of items (correlation with Spiritual Events scores: R = 0.65; with Daily Spiritual Experiences scores: R = 0.55).

We note that these interaction effects were likely driven by datapoints that are, in some sense, "outliers": As we would expect for experiences that are by definition "extraordinary," most participants in this sample reported relatively few spiritual presence events (and 26% reported none at all). In line with this, these interaction terms were generally not significant in regression analyses that corrected for skewness (e.g., via log transformation or rank-ordering;

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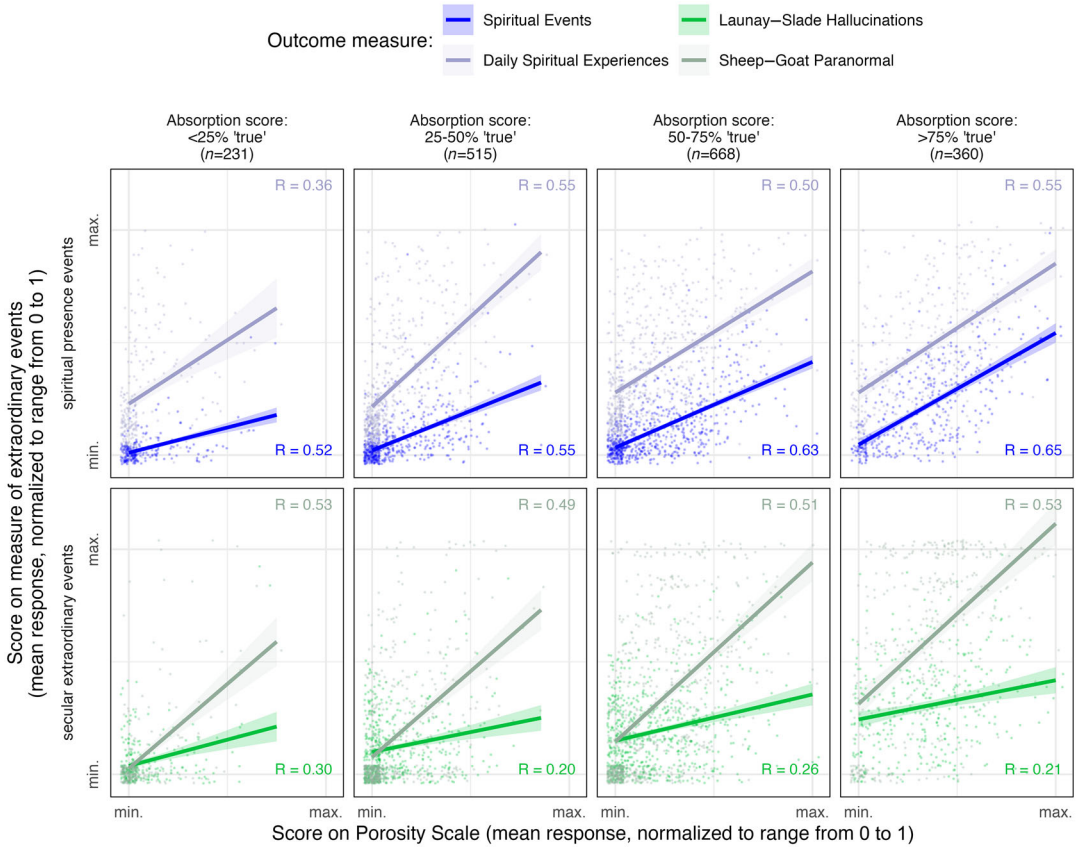

Fig. 2. Assessing the interaction between porosity and absorption in predicting reports of extraordinary experiences among all participants included in the current study ($N = 1779$). For spiritual presence events (top row), porous models of mind were particularly strongly associated with reports of spiritual presence events for individuals with a greater capacity for absorption, as evident in the increase in slopes and Pearson correlation coefficients from left to right; this interaction was particularly pronounced for the more "experiential" of our two measures of spiritual presence events (the Spiritual Events scale, in bright blue). We did not observe evidence for this interaction for secular extraordinary experiences (bottom row), although we caution against interpreting this as strong evidence against such an interaction. Small dots represent individual participants; smoothed lines represent simple linear regressions. For the purposes of this visualization, scores on all measures normalized to range from 0 (marked as "min.") to 1 (marked as "max.").

see Supporting Information: "Results: Section 2"). While we therefore urge some caution in interpreting the interactions reported here, we also maintain that very nature of these extraordinary events requires careful attention to (rather than outright dismissal of) the experiences and participants that might in some sense be considered "outlier" cases.

In sum, we consider this pattern of results to be preliminary evidence consistent with the idea that porous models of mind are particularly effective at facilitating spiritual presence events for individuals with a greater capacity for absorption—or, put differently, that

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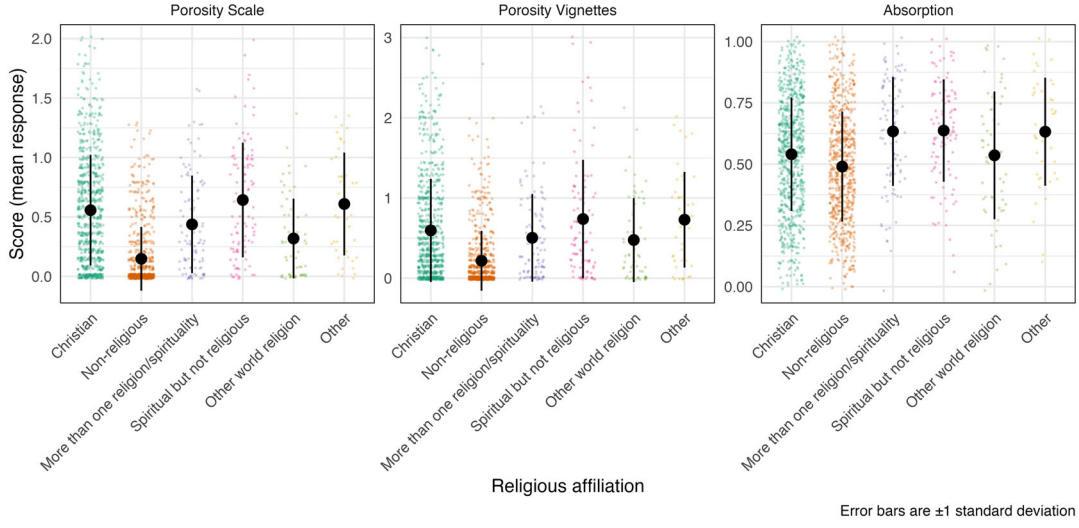

Fig. 3. Religious group differences were most pronounced in Porosity Scale scores, and least pronounced in Absorption scores. The plot depicts differences in scores on the Porosity Scale, Porosity Vignettes, and Absorption scales across Christian participants ($n = 768$), non-religious participants ($n = 702$), "Spiritual but not religious" participants ($n = 102$), and participants identifying with more than one religion ($n = 103$), another world religion ($n = 60$), or some other religious or spiritual tradition ($n = 44$). Small dots represent individual participants; large dots represent groupwise means; error bars are ± 1 standard deviation.

absorption is particularly effective at facilitating spiritual presence events for individuals who believe that the mind-world boundary might be porous.

We did not observe strong evidence for such an interaction in our analyses of secular extraordinary experiences (βs ranged from -0.008 to 0.04, all $|t|$s<2.45, all ps $> .014$); see Fig. 2, bottom row (Supporting Information, Fig. S01). We consider investigations of the similarities and differences between spiritual presence events and secular extraordinary experiences to be a fruitful area for future research.

How, then, do porosity and absorption work together to facilitate the experience of spiritual presence events? To address this question, we conducted a series of exploratory analyses into the nature and function of porosity and absorption.

3.3. Similarities and differences across religious groups shed light on the nature of porosity

We first examined similarities and differences across participants from different religious backgrounds in their endorsement of porous models of mind. (For the complete results of all regression models reported here, see Supporting Information, "Results: Section 3.")

Echoing our previous work (Luhrmann et al., 2021b), scores on our two indices of porosity varied substantially across cultural-religious groups, with participants who identified as Christian or as "Spiritual but not religious" more likely to endorse porous models of the mind than, for example, non-religious participants (see Fig. 3). As with most "cultural differences,"

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this variability across groups coexisted with substantial variability across individuals within each group. But again, echoing our previous work across international settings, religious group differences accounted for 21%–22% of the variance in Porosity Scale scores and 11%–14% of the variance in Porosity Vignettes scores, compared to only 4%–5% of the variance in Absorption scores (and 18%–19% of the variance in our primary measure of spiritual presence events, the Spiritual Events scale).

We consider this further evidence in support of porosity as a dimension of cultural models of the mind that varies primarily across social-cultural settings—and new evidence this variability is detectable even across cultural-religious groups within a single national setting (the United States).

Exploratory analyses of these group-wise comparisons lend further support to our understanding of porosity as a dimension of cultural differences in models of mind, demonstrating that different cultural-religious groups not only endorse porosity to different degrees but also model porosity in different ways. As illustrated in Fig. 4, there were several items that received substantially stronger endorsements from "Spiritual but not religious" participants than among the other groups (e.g., from largest to smallest difference in group means: *If someone is sick and you can't call or visit them, thinking good thoughts can still help them get better*; *some people can visualize a symbol and the visualization can change the world directly*; *if someone wishes in their mind that their friend finds a job [even without speaking the wish or praying to God], the spiritual effects of that wish can help their friend find a new job*; *evil thoughts can go out into the world like Wi-Fi or a radio and cause bad things to happen to other people*). Likewise, there were a few items that received stronger endorsements from Christian participants, compared to the "Spiritual but not religious" (from largest to smallest difference in group means: *Envious thoughts and feelings come from evil spirits*; *if you pray hard enough in your mind to God, you can bring back the dead*; *a simple prayer to God in your mind can cause you to win the lottery, or cure a person from AIDS*). These differences make good sense: the "Spiritual but not religious" were more focused than Christians on the power of thought (particularly, "positive thinking"), while Christians were more likely than the "Spiritual but not religious" to endorse scenarios that are more closely aligned with Christian doctrine (the power of prayer and the demonic origins of envy). There were some items that were endorsed by few participants from any of these U.S. cultural-religious groups—namely, items referring to extraordinary interventions on biological processes (curing AIDS, poisoning food, resurrection). However, even this apparent similarity within the current study highlights the importance of cultural influences when set alongside our previous work outside of the United States, in which some of these very items were among the most commonly endorsed Porosity Scale questions in certain settings: For example, in a general population sample from Ghana, 77% of participants said "It definitely happens" to the question about whether there are certain people who can hurt others or contaminate food with their stare; and in a general population sample from Vanuatu, 39% of participants said "It definitely happens" to the question about a prayer to God bringing someone back from the dead (data from Luhrmann et al., 2021b, Study 2).

These observations also serve to illustrate a more general point about porosity: There are many "porous" models of the mind. Highlighting porosity as a *dimension* of cultural models

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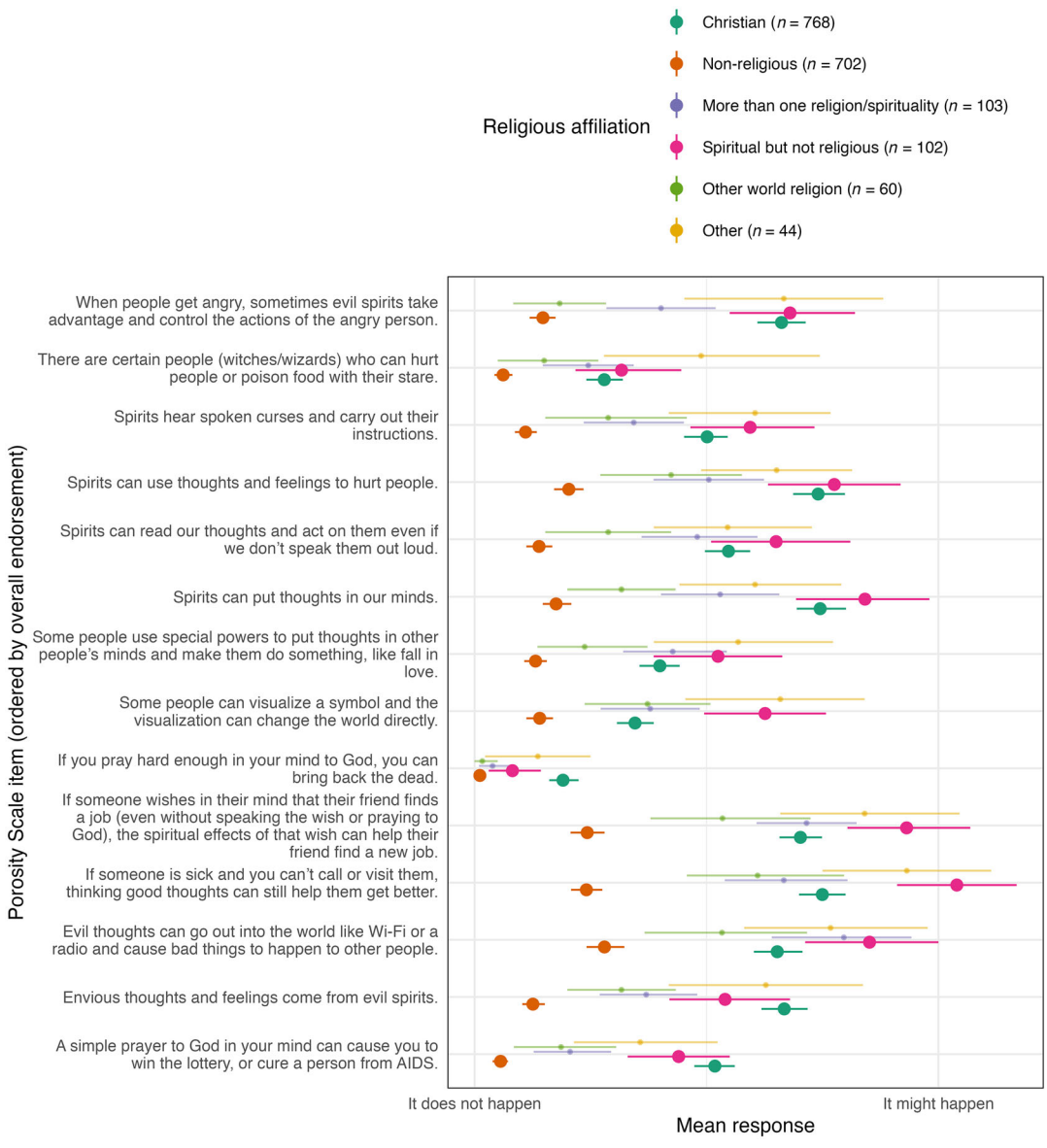
Religious affiliation
Christian (n = 768)
Non-religious (n = 702)
More than one religion/spirituality (n = 103)
Spiritual but not religious (n = 102)
Other world religion (n = 60)
Other (n = 44)
Porosity Scale item (ordered by overall endorsement)
When people get angry, sometimes evil spirits take advantage and control the actions of the angry person.
There are certain people (witches/wizards) who can hurt people or poison food with their stare.
Spirits hear spoken curses and carry out their instructions.
Spirits can use thoughts and feelings to hurt people.
Spirits can read our thoughts and act on them even if we don't speak them out loud.
Spirits can put thoughts in our minds.
Some people use special powers to put thoughts in other people's minds and make them do something, like fall in love.
Some people can visualize a symbol and the visualization can change the world directly.
If you pray hard enough in your mind to God, you can bring back the dead.
If someone wishes in their mind that their friend finds a job (even without speaking the wish or praying to God), the spiritual effects of that wish can help their friend find a new job.
If someone is sick and you can't call or visit them, thinking good thoughts can still help them get better.
Evil thoughts can go out into the world like Wi-Fi or a radio and cause bad things to happen to other people.
Envious thoughts and feelings come from evil spirits.
A simple prayer to God in your mind can cause you to win the lottery, or cure a person from AIDS.
It does not happen
It might happen
Mean response

Fig. 4. Mean responses to individual items from the Porosity Scale for Christian participants ($n = 768$), non-religious participants ($n = 702$), "Spiritual but not religious" participants ($n = 102$), and participants identifying with more than one religion ($n = 103$), another world religion ($n = 60$), or some other religious or spiritual tradition ($n = 44$). Three religious groups—Christian, non-religious, and "Spiritual but not religious" participants—are presented as larger, darker points to facilitate direct comparisons. Response options for the Porosity Scale included the two depicted here (scored as 0 and 1), as well as "It definitely happens" (scored as 2). Errors bars are bootstrapped 95% confidence intervals.

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of the mind allows us to place different models along a continuum from least to most porous. But the specifics of this permeability between mind and world—when, how, and why the boundary is crossed, how often, and by what or by whom—these are aspects of porosity that vary substantially across different communities of people (see also Luhrmann et al., 2021b; Luhrmann & Weisman, 2022).

Even as groups differed in the specifics of when and how a mind might be porous to the world, there were two similarities across participants that stood out.

First, in general, very few participants indicated that crossing the mind-world boundary happened in all possible ways. Only 2% of participants ($n = 44$) endorsed all of the items within the Porosity Scale (i.e., selected a response other than "It does not happen" for all items); only 11% ($n = 195$) endorsed for all of the items within the Porosity Vignettes (i.e., selected a response other than "Never" for all items); and only 2% of participants ($n = 37$) endorsing all items within both scales. Instead, "It does not happen" was the modal response on at least 50% of Porosity Scale items for all religious groups, even among Christians (86% of items) and the "Spiritual but not religious" (57% of items); and "Never" was the modal response on at least 70% of Porosity Vignettes items for all religious groups, even among Christians (94% of items) and the "Spiritual but not religious" (82% of items).

Second, even the more "bounded" participants in our sample generally stopped short of rejecting all porous possibilities outright. Only 33% of participants ($n = 593$) rejected all items within the Porosity Scale (i.e., selected the response "It does not happen" for all items); only 31% ($n = 548$) rejected all items within the Porosity Vignettes (i.e., selected the response "Never" for all items); and only 22% of participants ($n = 391$) rejected all items on both scales. Even among non-religious participants, full rejection was a minority response pattern (41% of non-religious participants, $n = 289$). Put another way, fully 78% of participants in this study—including 59% of those participants who considered themselves atheist, agnostic, or otherwise fully non-religious—endorsed at least one item that entailed some degree of porosity between mind and world. These endorsements, as weak and full of caveats as they might be, suggest that the vast majority of participants in this study left open at least some slight possibility that the boundary between mind and world might, under some conditions, be porous.

These findings were not driven by particularly high or low rates of endorsement for individual items; when we drop items which were endorsed by fewer than 25% or more than 50% of participants, for example, we still find this pattern of endorsing some but not all remaining items among fully 69% of participants ($n = 1233$), with only 5% of participants endorsing all remaining items and only 26% ($n = 454$) rejecting all remaining items.

A brief reanalysis of data from our previous studies aligns with these general observations. In a study of charismatic Christians and general population adults recruited in urban public settings in the United States, Ghana, Thailand, China, and Vanuatu (Luhrmann et al., 2021b, Study 2, $N = 1026$), only 2% of participants responded "It definitely happens" to all items in the Porosity Scale, and only 7% responded "It does not happen" to all items. (This study did not include the Porosity Vignettes measure.) Likewise, in a separate study of undergraduates in each of these five countries (Luhrmann et al., 2021b, Study 4, $N = 500$), only 2% of participants gave the most porous response to all items in both the Porosity Scale and Porosity

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Vignettes, and only 4% gave the least porous response to all items in both scales. These previous studies included a greater number of religious participants (in particular, many large samples of charismatic Christians); participants from a wider range of geographical, cultural, linguistic, and socioeconomic settings; and participants who were likely higher in religiosity than the U.S. adults included in the current online study. Nonetheless, even among these more religious and more diverse, international samples, there were exceedingly few individuals who endorsed a strictly "bounded" or strictly "porous" understanding of the mind.

In sum, the current study lends further support to our characterization of porosity as a dimension of cultural models of the mind that varies across social-cultural groups, even within the U.S. setting—not only in terms of the overall degree to which people in these communities endorse a porous mind-world boundary but also in terms of the specific ways in which this boundary is understood to be permeable or impermeable (i.e., the specific items that people in different religious groups tend to endorse or not endorse). Beyond this, these results lend further support to our argument that porosity is neither obvious nor exotic (Luhrmann & Weisman, 2022): In all of our studies of porosity to date, only a small minority of individuals endorse or reject all forms of porosity entirely. Despite differences across religious groups and individuals in the degree and nature of porosity, there was widespread consensus among participants that the mind-world boundary might occasionally be permeable—but only under specific circumstances.

3.4. Exploratory factor analysis sheds light on the function of absorption

If most people share the general idea that the mind-world boundary might be permeable under certain circumstances, how might absorption interact with this understanding to facilitate spiritual presence events?

To address this question, we sought to deepen our understanding of what absorption is, by conducting a series of exploratory analyses to examine the internal structure of the Absorption scale. We not only conducted exploratory factor analyses of the current dataset (see Supporting Information, "Results: Section 5," for details), but also both separate and pooled analyses of the 15 samples from our previous studies in the United States, Ghana, Thailand, China, and Vanuatu (Luhrmann et al., 2021b, Studies 1, 3, and 4). We provided a brief overview of these findings in Luhrmann et al. (2021a).

Here, we share the two major insights resulting from this extensive exploration.

First, we observed no evidence for a single, stable structure to the Absorption Scale in these studies. For each sample, different factor retention protocols (e.g., retaining factors with eigenvalues ≥ 1, parallel analysis, minimizing the Bayesian Information Criterion, implementing the Very Simple Structure or Minimum Average Partial criteria) suggested different numbers of factors. For each of the multi-site samples in our previous work, samples from different countries varied substantially in the number and nature of factors revealed by a given factor retention protocol; and for most of the five countries included in this line of studies, a substantially different factor structure emerged across the three samples. In several cases—particularly in some of our samples from Thailand, China, and the United States—there were some indications that there was no dimensional structure to speak of: One or more factor

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retention protocols suggested null, single-factor solutions. There were certainly analyses in which a factor emerged that isolated experiences of synesthesia, or "altered states of consciousness," or "aesthetic involvement in nature," or "imaginative involvement," or "sensed presence" (see Jamieson, 2005; Terhune & Jamieson, 2021). However, the high degree of variability across samples, studies, and analysis choices—even when considering only participants in the United States—pushes back upon the claim that scale can be resolved into five robust factors.

Together with the fact that the Absorption Scale was highly internally consistent in each of these samples—all Cronbach's $\alpha \geq 0.78$ across studies and samples reported in Luhrmann et al. (2021b); and $\alpha = 0.91$ in the current dataset (see Supporting Information, "Results: Section 3")—we see these findings as adding to a growing body of evidence suggesting that the Absorption Scale is a reliable index of a single underlying construct, but that different questions "hang together" in different ways for different groups of people in different circumstances (for one precedent for this conclusion, see Lee, Lee, Kim, & Sim, 2007).

Nonetheless, there was one commonality that stood out to us across most of these factor analyses: In all the many configurations of which questions correlated with which other questions to constitute however many factors, questions about vivid sensory experiences rarely loaded strongly on the same factor with questions about what we will refer to as the suspension of reality testing.

Perhaps the clearest demonstrations of this are the two-factor solutions for the current dataset ($N = 1779$ U.S. adults) and for the full pooled dataset from Luhrmann et al. (2021b), including all samples from all studies (total $N = 1362$ adults from the United States, Ghana, Thailand, China, and Vanuatu). See Fig. 5, which presents oblique ("oblimin") transformations of these two-factor solutions using polychoric correlations to account for the dichotomous nature of participants' responses. (We note that orthogonal "varimax" rotations yielded very similar results.)

In both cases, one factor was characterized by strong factor loadings ($\geq$0.45 in both solutions) for items related to sensing the presence of invisible others, mind-wandering, losing oneself in fiction, altering the way one engages in sensory experience, and other unusual modes of experiencing the world. What many of these items have in common, in our view, is that they involve some sort of break from one's "normal" way of conceptualizing the world. Many of these experiences require a person to temporarily suspend disbelief, doubt, or other aspects of "reality-testing"—perhaps even suspending their interest in what is or is not "real" altogether—and relate to the world in a non-ordinary way, entertaining possibilities that they might otherwise reject in their typical state of being (e.g., the possibility that someone is present even though I cannot see them; that I am Othello; that my mind envelops the world).

The other factor was characterized by high factor loadings ($\geq$0.45) for items related to taking delight in sensory and imaginative experiences (such as sunsets, soap bubbles, clouds, and flames), being completely immersed in fiction or nature, experiencing synesthesia, and having intense visual imagery. In our view, what these items have in common is the heightened place of immersive or otherwise vivid sensory perceptions. This second factor—what we have characterized as the intensification of sensory experience—is quite similar to how we and

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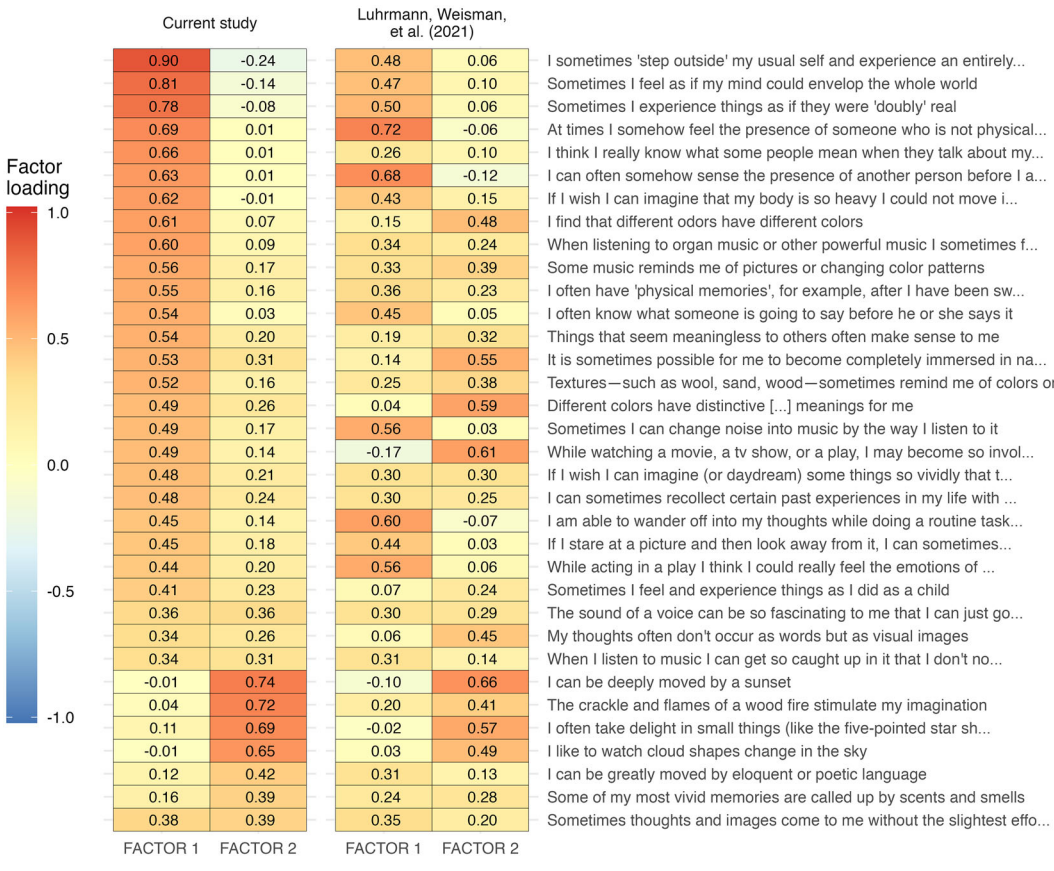
Current study
Luhrmann, Weisman, et al. (2021)
Factor loading
1.0
0.5
0.0
-0.5
-1.0
0.90 -0.24 0.48 0.06 I sometimes 'step outside' my usual self and experience an entirely...
0.81 -0.14 0.47 0.10 Sometimes I feel as if my mind could envelop the whole world
0.78 -0.08 0.50 0.06 Sometimes I experience things as if they were 'doubly' real
0.69 0.01 0.72 -0.06 At times I somehow feel the presence of someone who is not physical...
0.66 0.01 0.26 0.10 I think I really know what some people mean when they talk about my...
0.63 0.01 0.68 -0.12 I can often somehow sense the presence of another person before I a...
0.62 -0.01 0.43 0.15 If I wish I can imagine that my body is so heavy I could not move i...
0.61 0.07 0.15 0.48 I find that different odors have different colors
0.60 0.09 0.34 0.24 When listening to organ music or other powerful music I sometimes f...
0.56 0.17 0.33 0.39 Some music reminds me of pictures or changing color patterns
0.55 0.16 0.36 0.23 I often have 'physical memories', for example, after I have been sw...
0.54 0.03 0.45 0.05 I often know what someone is going to say before he or she says it
0.54 0.20 0.19 0.32 Things that seem meaningless to others often make sense to me
0.53 0.31 0.14 0.55 It is sometimes possible for me to become completely immersed in na...
0.52 0.16 0.25 0.38 Textures—such as wool, sand, wood—sometimes remind me of colors or ...
0.49 0.26 0.04 0.59 Different colors have distinctive [...] meanings for me
0.49 0.17 0.56 0.03 Sometimes I can change noise into music by the way I listen to it
0.49 0.14 -0.17 0.61 While watching a movie, a tv show, or a play, I may become so invol...
0.48 0.21 0.30 0.30 If I wish I can imagine (or daydream) some things so vividly that t...
0.48 0.24 0.30 0.25 I can sometimes recollect certain past experiences in my life with ...
0.45 0.14 0.60 -0.07 I am able to wander off into my thoughts while doing a routine task...
0.45 0.18 0.44 0.03 If I stare at a picture and then look away from it, I can sometimes...
0.44 0.20 0.56 0.06 While acting in a play I think I could really feel the emotions of ...
0.41 0.23 0.07 0.24 Sometimes I feel and experience things as I did as a child
0.36 0.36 0.30 0.29 The sound of a voice can be so fascinating to me that I can just go...
0.34 0.26 0.06 0.45 My thoughts often don't occur as words but as visual images
0.34 0.31 0.31 0.14 When I listen to music I can get so caught up in it that I don't no...
-0.01 0.74 -0.10 0.66 I can be deeply moved by a sunset
0.04 0.72 0.20 0.41 The crackle and flames of a wood fire stimulate my imagination
0.11 0.69 -0.02 0.57 I often take delight in small things (like the five-pointed star sh...
-0.01 0.65 0.03 0.49 I like to watch cloud shapes change in the sky
0.12 0.42 0.31 0.13 I can be greatly moved by eloquent or poetic language
0.16 0.39 0.24 0.28 Some of my most vivid memories are called up by scents and smells
0.38 0.39 0.35 0.20 Sometimes thoughts and images come to me without the slightest effo...
FACTOR 1 FACTOR 2 FACTOR 1 FACTOR 2

Fig. 5. Factor loadings from two of the many exploratory factor analyses conducted over items of the Absorption Scale: Although the two solutions differ, in both cases Factor 1 includes prime examples of the suspension of reality testing, while Factor 2 includes prime examples of the intensification of sensory experience. These analyses included participants from the current study ($N = 1779$ U.S. adults), left panel; and all participants in all studies from Luhrmann et al. (2021b); $N = 1362$ adults from the United States, Ghana, Thailand, China, and Vanuatu). Factor loadings reflect oblique transformations.

many other scholars have discussed "absorption" in previous work: an attitude of interest and curiosity toward the mind, an immersive orientation toward sensation.

When scholars discuss absorption, it is often this second sense of absorption—the intensification of sensory experience—that looms large in their descriptions. But there are also precedents for understanding absorption in the first sense as an enhanced capacity to suspend reality testing. For example, in their original paper, Tellegen and Atkinson (1974) described absorbed attention as generating an "altered sense of reality" (p. 274) and described high-absorption individuals as having a "distinctive cognitive style" characterized by "unconventional and idiosyncratic appraisals" (p. 275). When Tellegen (1981) later characterized high-absorption individuals as being disposed to an "experiential" rather than "instrumental" mindset, that is, as tending to engage with experiences themselves rather than assessing their instrumental

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utility to achieving one's goals or accurately representing the world, he was describing the capacity to put to one side the demands of everyday life to allow oneself to daydream, to imagine something different from the practical everyday (see also Atkinson, 1994; Terhune & Jamieson, 2021). The empirical distinction between vivid sensory experience and the suspension of reality testing that emerges from the current analyses and re-analyses, we would argue, thus harkens back to the early theoretical roots of the Absorption Scale. Indeed, Tellegen himself sometimes suggested that the scale could be broken down into subscales of what he termed "sentience" (characterized by a focus on sensory experiences of external objects or events) versus "altered states" (characterized by a focus on internal experiences facilitated by the imagination; Tellegen, August 17, 2017, personal correspondence to Michael Lifshitz). (For recent empirical work employing such subscales, see van Eyghen & Cardeña, manuscript under review.)

The one factor is an epistemic stance, and the other an experiential orientation, and they work together because the first allows someone to tolerate a sense of the world different from the everyday, and the second gives that imagined different enough weight to feel real or almost real. The observation that imagination demands both epistemic and experiential inclinations is often attributed to Aristotle, who pointed out that for the audience of a play to experience catharsis, they must ignore the blunt reality that the story was not real and also be swept up into the tale as if it were; Coleridge coined the phrase "suspension of disbelief" to describe the capacity to ignore the unreality of a ghost so as to be drawn into a vivid story—a skill he described as the heart of "poetic faith." The point, as Walton (1978) observed, was not that someone ignored reality but rather allowed oneself to become immersed in an internally consistent fictional world and to respond to it, within limits, as if it were real—motivated in part because that internally consistent fictional world feels vivid to the one who is immersed in it.

Again, the overarching takeaway from our many wide-ranging exploratory analyses of the Absorption Scale in these studies is that it was highly internally consistent across diverse samples (more consistent than other existing measures; see Luhrmann et al., 2021b) and that we did not observe any robust, stable factor structure (even within our samples from the United States and certainly not across samples from different cultural settings). Thus, we urge readers not to place too much weight on the precise patterns of factor loadings displayed in Fig. 5. Instead, we emphasize that across nearly all of our analyses, we observed one or more factors that we would characterize as being related to the suspension of reality-testing (similar to the first factors represented in these example analyses), and one or more factors that we would characterize as being examples of the intensification of sensory experience (similar to the second factors). This helps us to reconceptualize absorption not *just* as an "experiential factor," as we have described it in the past (Luhrmann et al., 2021b), but as an ability to recruit both experiential and epistemic faculties to become immersed in something beyond the immediate, material reality of the here and now.

4. General discussion

We think, wrote Descartes, and thus we know that we are. Cognitive scientists often approach thought as a mechanism. They look for the metaphorical strings that make the

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puppet of consciousness dance, the implicit structure of language and logic that shapes the way humans make judgments. But thought is also an experience: what it is like to be a being (Nagel, 1974), what it is like to be you (Seth, 2021). We are aware of our awareness, and this sense of being aware is shaped by culture and history and the happenstance of temperament and those features in turn shape the quality of that experience. Cognitive science deeply understands that expectation affects experience, but cognitive science has for the most part not developed the insight that the way people imagine their thought and feel their thought may shape how their thought is experienced. We seek to develop that insight here.

In a large-scale study of U.S. adults, we have shown that two factors concerning how people feel and conceptualize thought—absorption and porosity—work together to transform a person's own thoughts and inner sensations into the kinds of extraordinary experiences of spiritual presence that are so important in so many human lives.

Before turning to the theoretical advances this new work has afforded, we note that we consider this a robust replication of our previous findings (Luhrmann et al., 2021b): As predicted and preregistered, *porosity* (i.e., the degree to which a person endorses the possibility that thoughts and feelings might sometimes cross the boundary between mind and world) and *absorption* (i.e., the degree to which a person reports being able to enter into a heightened state of immersive, sensorially rich attention to inner and outer events) were distinct positive predictors of spiritual presence events in this sample, robust to a variety of methodological and analytical choices. In contrast to our previous studies, in which experienced fieldworkers conducted extensive face-to-face interviews with religious practitioners in a variety of international settings, the current sample—experienced Prolific users based in the United States—was certainly a sample of convenience. We consider it valuable to have documented that a sample of so-called "professional survey-takers" yielded such similar results to our previous work in the field; such participants were far less likely to be confused by our questions or to have their responses unduly influenced by low-level features of the survey measures, lending us further confidence in our interpretation of these results as echoes of causal relationships rather than artifacts of mere response biases.

In our view, however, the primary contribution of the current study is that it enabled thorough exploratory analyses of porosity, absorption, and their joint influence on spiritual presence events.

We begin with the finding that motivated this large-scale study in the first place: the possibility that porosity and absorption might work *together* to facilitate spiritual presence events. The current study provided the first empirical evidence of a positive statistical interaction between porosity and absorption in predicting reports of spiritual presence: Their combined effect was greater than the sum of its parts. We consider this pattern of results to be consistent with the idea (which we have heretoforth offered only as speculation; see Luhrmann & Weisman, 2022) that porosity and absorption are distinguishable but nevertheless interrelated predictors of spiritual presence events. We now have evidence that individuals who have both a high capacity for absorption and access to a highly porous model of the mind-world boundary may be even more likely to experience their own thoughts as not their own as if these thoughts had sensory content—even as if they were the product of other minds who speak or act (i.e., gods and spirits).

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The main phenomenon here is that, under the right circumstances, a thought can be experienced as being on the "other" side of an implicit boundary between mind (self) and world. As we point out, the idea that thoughts can occasionally cross that threshold is neither obvious nor exotic. In the current paper, both exploratory analyses of the current dataset and reanalyses of our previous datasets provide overwhelming evidence that, at the individual level, nearly all participants had access to both "porous" and "bounded" mental models of the mind; only a small minority endorsed or rejected all forms of porosity entirely. Put another way, there was widespread consensus among the thousands of individuals in our studies in that the mind-world boundary is typically quite solid but might occasionally be permeable under specific circumstances. What varied across individuals was not whether a participant's (single) model of the mind was porous or bounded but instead the relative ease with which they could engage with a more porous model of mind.

In part, this variability is the work of culture. Among the U.S, adults in the current study, Christian participants and "Spiritual but not religious" participants tended to endorse more porous models of mind than other participants. As in our previous work comparing international settings, cultural group membership (in this case, religious group membership) accounted for a particularly large proportion of the variance in porosity scores, compared to the other variables we measured in this study. Beyond the sheer degree of porosity, we also found that the specific nature of porosity varied across cultural-religious groups. Item-level analyses of the current study as well as our previous studies revealed that individuals from different cultural groups varied substantially in the specific circumstances under which they believed thoughts and feelings might pass directly between mind and world; for example, the "spiritual but not religious" participants in the current study were particularly confident about the power of positive thinking, while Christians were more likely to endorse porous concepts related to prayer and to demons.

These cultural models of mind, in turn, inform individuals' mental models of mind—but they do not determine them. That is, we think, because people do not have one single model of how the mind works but rather multiple models, evoked for different purposes on different occasions, much as they have multiple senses of self and ways of being in the world (e.g., Markus & Kitayama, 2010).

Here is where absorption matters. We suggest that what varies across individuals is not whether their (single) model of the mind is porous or bounded but instead the relative ease with which they can reach out for a more porous model. In fact, as we alluded to in the introduction to this paper, we suggest that most people in most cultural settings default to a relatively bounded understanding of the mind in much of their daily life: The sense that "I" am "in here" and "you" are "in there"; the idea that in order to convey our thoughts and feelings to each other we need to speak or act; the feeling that my inner life originates within myself—in our view, these kinds of "bounded" intuitions are basic, functional assumptions underlying large swaths of most days in most human lives. And yet, we argue that everyone has moments in which this mundane model of mind fails to account for their experience—thoughts that pop into the mind so strongly and spontaneously that they just do not feel like one's own; coincidences that feel too profound to be truly coincidental; dreams, premonitions, gut feelings, and so on that seem to demand alternative explanations. It is such experiences

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that undergird the porosity that features in some cultural models of mind—but beyond this, individuals' reactions to these moments of conflicting intuition vary substantially. For some, these are brief glimpses of porosity that quickly recede against an overwhelming commitment to the default, mundane model of mind. Others, however, are able to sustain these moments, dwell in these experiences, and inhabit more fully an alternative way of thinking and being. This tendency to dwell in vivid mental and sensory experiences is how we would now describe "absorption."

Based on our wide-ranging analyses and re-analyses of responses to the Absorption scale in the current dataset and in our previous datasets, we believe that absorption works in two ways to enable someone to dwell in these more porous modes.

First, the suspension of reality testing makes it easier to switch between modes of being and thinking—in particular, to switch away from a more default or mundane explanatory framework (e.g., a bounded model of mind) to an alternative explanatory framework (e.g., a more porous model of mind). Individuals who are adept at suspending reality testing are better able to switch between explanatory frameworks because, by temporarily suspending their assessment of what is "real" or "true," they are liberated from having to resolve potential tensions between these different epistemic frames. In contrast, individuals who are more committed to maintaining reality testing will more easily "snap out" of the alternative (e.g., porous) way of thinking because they are more likely to detect, attend to, and attempt to resolve such conflicts (typically in favor of a default mode or model, by definition). Put another way, this aspect of absorption indexes a specific cognitive attitude of "epistemic flexibility": an ability to reason about and experience the world via some alternative explanatory framework without attempting to reconcile conflicts with more typical ways of thinking and being.

Second, the intensification of sensory experience serves to make an alternative mode of being and thinking feel more real. Individuals who are adept at intensifying their sensory experiences can take some kernel of stimulus—a thought, a sensation, a bit of perceptual information—and attend to it, elaborate on it, sustain it, and even transform it without further external stimulation. In the case of switching between default and alternative explanatory frameworks, this allows the "alternative" explanation or way of being to compete on more even footing with a default epistemic frame: The default may feel correct because it is so often invoked, but the alternative may feel real because it is supported by such vivid sensory richness. (This aspect of absorption has been the primary way in which we have explained the connection between absorption and experiences of spiritual presence events in much of our previous work; see, e.g., Luhrmann, Nusbaum, & Thisted, 2010, 2021b; Luhrmann & Weisman, 2022.)

In sum, we propose that the experience of spiritual presence events—which at their core are thoughts experienced as not one's own—is facilitated by a dynamic interaction between mental models and cognitive-epistemic attitudes: A person is more likely to hear God speak if they have the cultural support and epistemic flexibility to shift, temporarily, away from a mundane model of mind into a more "porous" way of thinking and being, and the ability to intensify their own sensory experiences in a way that makes the porous model feel real.

We conclude with a more speculative suggestion, calling out for further research: that the ability to shift between explanatory frameworks, facilitated by a combination of epistemic

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flexibility and inner sensory vividness, plays a role in many domains beyond religion. The capacity to imagine something different from the world before one—to feel that it is there, that it matters, that it is not fey or foolish—is required for writing fiction and for scientific discovery, to name just two examples.

Fiction writers must be able to enter into a landscape that does not exist, inhabited by people they imagine: The more vividly they imagine it, the less distracted they are by the everyday, and perhaps the more they are able to write it down. The more they are able to take that world seriously—to suspend their disbelief in it as mere imagination—the more too they may be able to create. Remarkably, fiction writers do often experience their characters as feeling real in the world, and as if these characters were dictating their own stories rather than being invented by their creators. A study at the 2014 and 2018 Edinburgh International Book Festival found that two third of the writers reported hearing their characters' voices and one half described some sensory experiences of their characters (Foxwell, Alderson-Day, Fernyhough, & Woods, 2020). In this sense, the experience of composing fiction might—at least for some writers—be quite similar to the experiences of spiritual presence events that were the focus of the current study and similarly reliant on some engagement with a porous model of mind: Experiences in which thoughts are experienced as originating from another being (in the religious case, a god or spirit; in the case of fiction, a character).

A similar process might even be at play when porosity is not involved. The most striking example of this is scientific discovery: In moments of major scientific advancement, the scientist must hold in their mind an insight at startling variance from their previous expectations of the world. When the organic chemist August Kekule—the principal founder of the theory of chemical structure—dreamed of a snake eating its tail and awoke to find that he has solved the structure of the benzene ring, he had to shift into a sensorily vivid state that he did not reject as fanciful in order to recognize that he had seen an answer to his problem. (See Barrett, 2011, for more accounts of the importance of visual dreams for scientific problems.) In conscious waking life, vividly imagined thought experiments are often critical steps in scientific advancement, allowing theoretical advancements that might not be otherwise possible (e.g., facilitating conclusions that would not be rationally justifiable by virtue of argument from facts alone; Gendler, 1998). Famous historical examples of scientific advancements directly tied to visual thought experiments include Galileo's refutation of the Aristotelian thesis that an object falls at a speed directly proportional to its weight; Stevinus' insights about the mechanical advantage of inclined planes; and Einstein's theories of special relativity and general relativity (for extensive relevant discussions, see Gendler, 2004; Levy & Godfrey-Smith, 2019; Nersessian, 1992, 2017, 2024). On our characterization, such scientific thought experiments hinge on temporarily shifting away from a default model of the way the world is generally understood to work and instead entertaining the possibility that it might work in a different way—a shift from default to alternative explanatory frameworks that, we postulate, benefit from the same kind of epistemic flexibility and intensification of sensory experience that facilitates spiritual experience and fiction writing. (See Ma, Payir, McLoughlin, & Harris, 2024, for further discusssion of parallels between learning in religious vs. scientific domains.)

Shifting between mental models—models of mind, models of physics, perhaps even models of society or models of self—is one of the most important human cognitive abilities,

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critical for all kinds of scientific, personal, and social progress. The study of spiritual experience provides one template for how the human cognitive-perceptual apparatus accomplishes such an incredible feat as imagining a different reality and experiencing it as real.

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Note

1 This paragraph is based on a description drafted collectively by the original Mind and Spirit team for use in many of the scholarly works to emerge from this project. Contributors to this description included Felicity Aulino, Joshua D. Brahinsky, John C. Dulin, Vivian A. Dzokoto, Tanya M. Luhrmann, Emily Ng, Nicole Ross-Zehnder, Rachel E. Smith, and Kara Weisman.

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